FOURTH, UPDATED SAFETY EVALUATION: EMISSIONS FROM THE GAS-FLARE AND ENGINE AT THE ALPHA RIDGE LANDFILL

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This safety evaluation updates assessments that we have presented in December, 2011 (Green, 2011; Green & Zemba, 2011), March, 2012 (Green & Zemba, 2012a), December, 2012 (Green & Zemba, 2012b), and July, 2013 (Green & Zemba, 2013) with regard to impacts from emissions to ambient air from the combustion of gas at the Alpha Ridge Landfill, in Marriottsville, Maryland.

By way of brief review: In the autumn of 2011, we were asked to evaluate whether burning gas from the Alpha Ridge Landfill in a proposed GE Jenbacher internal combustion engine would be safe. Based on gas composition data from the Landfill, and emissions test-data from gas combustion systems at other landfills, we determined that impacts to ambient air, and hence to public health, would be inconsequential (Green, 2011; Green & Zemba, 2011). Thus, the proposed combustion would be safe.

In response to community concerns, Howard County committed to testing the Alpha Ridge Landfill flare and, once installed on site, the proposed Jenbacher engine; and we committed to re-running our analyses based on these test data.

Test-data for the flare became available in March, 2012. We re-evaluated impacts to ambient air based on these data and found, as expected, that impacts remained inconsequential (Green & Zemba, 2012a).

Test-data from the Jenbacher engine became available after it commenced operating in the latter half of 2012 (Avogadro, 2012). As we described in December, 2012, our updated evaluation continued to indicate safety (Green and Zemba, 2012b).

Additional samples of the Jenbacher engine exhaust were collected in May, 2013 and December, 2013. Test results were similar to initial testing of the engine, although some pollutants were detected at somewhat higher concentrations in one or both of the tests.

As shown below (Table 1), 26 *potentially* hazardous substances were detected in trace concentrations in the engine exhaust in one or more of the three sampling events of the Jenbacher engine, and most (17 of 26) were found at levels lower than we had assumed in our March, 2012 health evaluation update. Importantly, as indicated in Table 2, the modeled maximum impacts from all chemicals are still well within safe limits.

Table 1 Chemical emission rates based on tests of the Jenbacher engine at the Alpha Ridge Landfill, compared with levels assumed in our March, 2012 Safety Evaluation

Chemicals detected in Jenbacher engine exhaust testing at Alpha Ridge	Highest emission rate measured in three engine sampling events [A] (µg/s)	Emission rate assumed in March 2012 Safety Evaluation (µg/s)	Ratio of measured to assumed rate
Acetone	832	75.1	11.1
Benzene	302	319	0.95
Butane	11.2	2.4	4.77
Carbon Disulfide	59.2	61.9	0.96
Chlorobenzene	6.30	5.54	1.14
Chloromethane	5.42	23.5	0.23
1,4-Dichlorobenzene	11.7	12.2	0.96
cis-1,2-Dichloroethylene	2.52	3.75	0.67
1,4-Dioxane	15.1	35.7	0.42
Ethanol	51.7	21.6	2.40
Ethylbenzene	4.79	30	0.16
Freon 12 (Dichlorodifluoromethane)	27.7	14.1	1.97
Freon 114 (1,2-Dichloro-1,1,2,2-tetrafluoroethane)	4.03	5.91	0.68
Heptane	3.15	85.4	0.04
Hexane	41.6	28.1	1.48
Isopropyl alcohol (2-Propanol)	16.4	36.6	0.45
Methylene chloride (Dichloromethane)	11.8	54.4	0.22
Methyl ethyl ketone (2-Butanone)	20.2	43.2	0.47
Naphthalene	26.5	N/A	N/A
Propene	1250	11.3	111
2,3,7,8-Tetrachlorodibenzo(*p*)dioxin toxic equivalents (2,3,7,8-TCDD TEQs; "dioxins and furans")	0.00000949	0.0000703	0.13
Tetrahydrofuran	3.15	5.82	0.54
Toluene	55.4	103	0.54
1,2,4-Trimethylbenzene	8.06	35.7	0.23
Vinyl chloride	11.6	2.25	5.15
Xylenes (mixed isomers)	16	291	0.055

[A] The emission rate reported from each sampling event is the average of three test runs. The highest emission rate reported from any of the three sampling events is selected to account for potential variability.

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Table 2 Modeled ambient air impacts due to emissions from the Jenbacher engine and flare at the Alpha Ridge Landfill. The *italicized* values reflect the highest emission rates reported from the three engine sampling events [A] and are updated relative to our March, 2012 Safety Evaluation.

Emitted chemical	Maximum residential impact — micrograms per cubic meter of ambient air (µg/m³)	Harmless concentration (µg/m³) [B]	Is impact harmless?
Acetone	*0.004*	30,900	Yes
Benzene	*0.002*	3	Yes
Butane	*0.00006*	2,700	Yes
Carbon disulfide	*0.0004*	700	Yes
Chlorobenzene	*0.00004*	50	Yes
Chloroethane	0.00002	10,000	Yes
Chloromethane	*0.00005*	13	Yes
Cumene (Isopropylbenzene)	0.000004	400	Yes
Cyclohexane	0.00003	6,000	Yes
Decane	0.002	3,500	Yes
1,2-Dichlorobenzene	0.0001	200	Yes
1,3-Dichlorobenzene	0.00009	70	Yes
1,4-Dichlorobenzene	*0.00007*	2	Yes
1,1-Dichloroethane	0.00002	15	Yes
cis-1,2-Dichloroethene	*0.00002*	7	Yes
trans-1,2-Dichloroethene	0.00002	60	Yes
1,2-Dichloropropane	0.00005	2	Yes
1,4-Dioxane	*0.0001*	5	Yes
Ethanol	*0.0003*	430	Yes
Ethylbenzene	*0.00006*	9	Yes
Ethylene dibromide (1,2-Dibromoethane)	0.00004	0.04	Yes
Freon 12 (Dichlorodifluoromethane)	*0.0002*	100	Yes
Freon 113 (1,1,2-Trichloro-1,2,2-Trifluoroethane)	0.00003	30,000	Yes
Freon 114 (1,2-Dichloro-1,1,2,2-tetrafluoroethane)	*0.00003*	8,000	Yes
Heptane	*0.0001*	1,900	Yes
Hexane	*0.0002*	700	Yes
Hydrogen sulfide	0.001	2	Yes
Isopropyl alcohol (2-Propanol)	*0.0001*	7,000	Yes
Methylcyclohexane	0.0002	3,000	Yes
Methylcyclopentane	0.00008	1,400	Yes
Methylene chloride (Dichloromethane)	*0.0001*	600	Yes

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Emitted chemical	Maximum residential impact — micrograms per cubic meter of ambient air (µg/m³)	Harmless concentration (µg/m³) [B]	Is impact harmless?
Methyl ethyl ketone (2-Butanone)	*0.0001*	5,000	Yes
Methyl isobutyl ketone (4-Methyl-2-pentanone)	0.0004	3,000	Yes
Methyl tert-butyl ether (MTBE)	0.00002	90	Yes
Naphthalene	*0.0001*	0.7	Yes
Nonane	0.001	20	Yes
Pentane	0.00003	1,000	Yes
Propene	*0.006*	3,000	Yes
n-Propylbenzene	0.000001	1,000	Yes
2,3,7,8-Tetrachlorodibenzo(*p*)dioxin toxic equivalents (2,3,7,8-TCDD TEQs; "dioxins and furans")	*0.0000000001*	0.0000006	Yes
1,1,2,2-Tetrachloroethane	0.0001	0.4	Yes
Tetrachloroethylene	0.00004	40	Yes
Tetrahydrofuran	*0.00002*	2,000	Yes
Toluene	*0.0004*	5,000	Yes
1,1,1-Trichloroethane	0.00005	5,000	Yes
1,2,4-Trimethylbenzene	*0.00008*	7	Yes
Trichloroethylene	0.00005	2	Yes
1,3,5-Trimethylbenzene	0.0001	6	Yes
Vinyl chloride	*0.00006*	5	Yes
Xylenes (mixed isomers)	*0.0004*	100	Yes

[A] The emission test reported from each sampling event is the average of three test runs. The highest emission rate reported from any of the three sampling events is selected to account for potential variability.

[B] Harmless concentrations are based on values published by U.S. EPA and other government sources, and incorporate ample margins of safety, such that they pose no significant risk to health.

Note that Table 2 contains more substances than have been found in the engine exhaust testing, as reflected in Table 1, because some additional substances found in the previous

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testing of the flare emissions or raw landfill gas have been included.[1] Additionally, toxicity values used in the evaluation have been checked and updated.

Overall, then, this updated evaluation agrees with our earlier assessments in demonstrating no significant impacts to ambient air or to public health from combustion of gas at the Alpha Ridge Landfill.

[1] See the original March, 2012 evaluation for details.

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References

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